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(54) Optical data recording/reproducing method and apparatus

(57) The present invention provides an optical data recording/reproducing method wherein a data is recorded for testing in a pattern consisting of a not-recorded section and a recorded section as changing a recording power P onto an optical data recording medium from time to time, an amplitude m of the recorded data corresponding to the recording power P is monitored by reproducing the data recorded for testing, a standardized gradation g(P) is calculated from the following expression:

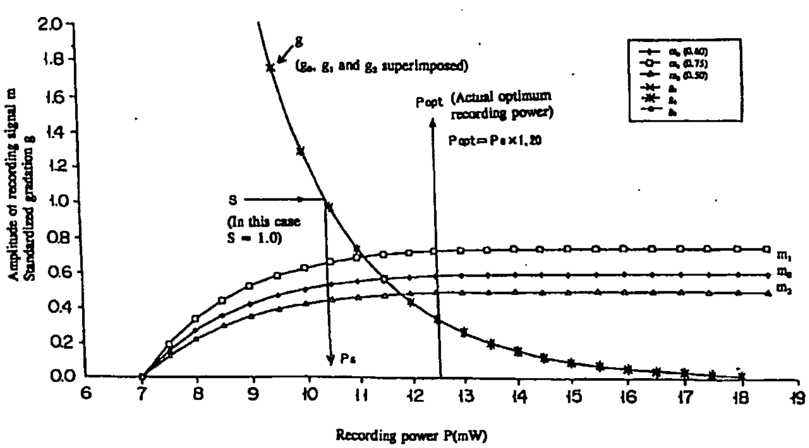
$$g(P)=(\Delta m/m)/(\Delta P/P)$$

or h(P) is calculated from the following expression:

$$h(P)=(\Delta m/m)/\Delta P$$

wherein ΔP indicates a minute change rate near P and Δm indicates a minute change rate corresponding to ΔP near m, and an optimum recording power is decided and set by evaluating excess or shortage of the recording power according to said standardized gradation g(P) or h(P).

FIGURE 4



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Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to an optical data recording/reproducing method and apparatus.

DISCUSSION OF THE BACKGROUND

There has been known a method for recording data signals in an optical data recording medium for use in an optical data recording/reproducing apparatus by irradiating a light spot such as a laser beam onto an optical data recording medium for scanning and modulating amplitude of a light spot such as a laser beam with data signals as described in Japanese Patent Publication No. 29336/1988, and also there has been a method for adjusting recording conditions such as a recording power or a recording light pulse to optimum ones by way of reproducing data signals recorded in an optical data recording medium and monitoring an amplitude of the reproduced signals or a length of recording marks.

With any of the technologies as described above, as a matter of fact it is impossible due to the reasons as described below to always set optimum conditions even though data signals is actually recorded using an optical data recording/reproducing apparatus produced in mass.

Namely, as an example of the method described above, the method can be enumerated in which an optimum recording power is set to each optical data recording/reproducing apparatus by monitoring an amplitude of recording signal (a difference between a level of a signal from a not-recorded section and that of a signal from a recorded section) ,which is a representative reproduced signal in an optical data recording medium, but an amplitude value of a recording signal changes according not only to a recording power, but also to a number of openings in an optical pickup, rim intensity (distribution of intensity of an incident laser beam to a focusing lens) ,a size and a form of each light spot, and contamination of the optical system associated with passage of time, and generally offset by 20 to 40% is generated between each optical pickup, so that a set value is largely displaced from the optimum one because of the effect by the offset described above.

So in an optical data recording/reproducing apparatus designed for mass production, it is extremely difficult to set an optimum recording power with a precision acceptable in actual use (around ± 5%). Also there is nonuniformity between individual optical data recording/reproducing apparatus that an amplitude of recording signal for the same recording power can not be a constant level, and in this case, minute adjustment of a recording power is required for each optical data recording/reproducing apparatus. There is a problem in production of the optical data recording/reproducing apparatus.

Moreover, especially, in a repeatedly rewritable optical data recording medium, a test recording is executed in a data track and then an optimum recording power is set. After that, the test data can be erased and a new data can be recorded, or a new data can be overwritten directly in the track in which the test recording is executed. So, though a data track exclusive for testing need not be formed as the postscript type optical data recording medium, it is not prevented that the recording power of the test recording is excessively increased and the data track is damaged. Therefore, as a matter of fact, the data track exclusive for testing need be formed, and there are disadvantages that a setting error of an optimum recording power is enlarged due to a difference of recording characteristic which is due to a position difference of each data track, or the data track exclusive for testing is in vain for a user.

SUMMARY AND OBJECT OF THE INVENTION

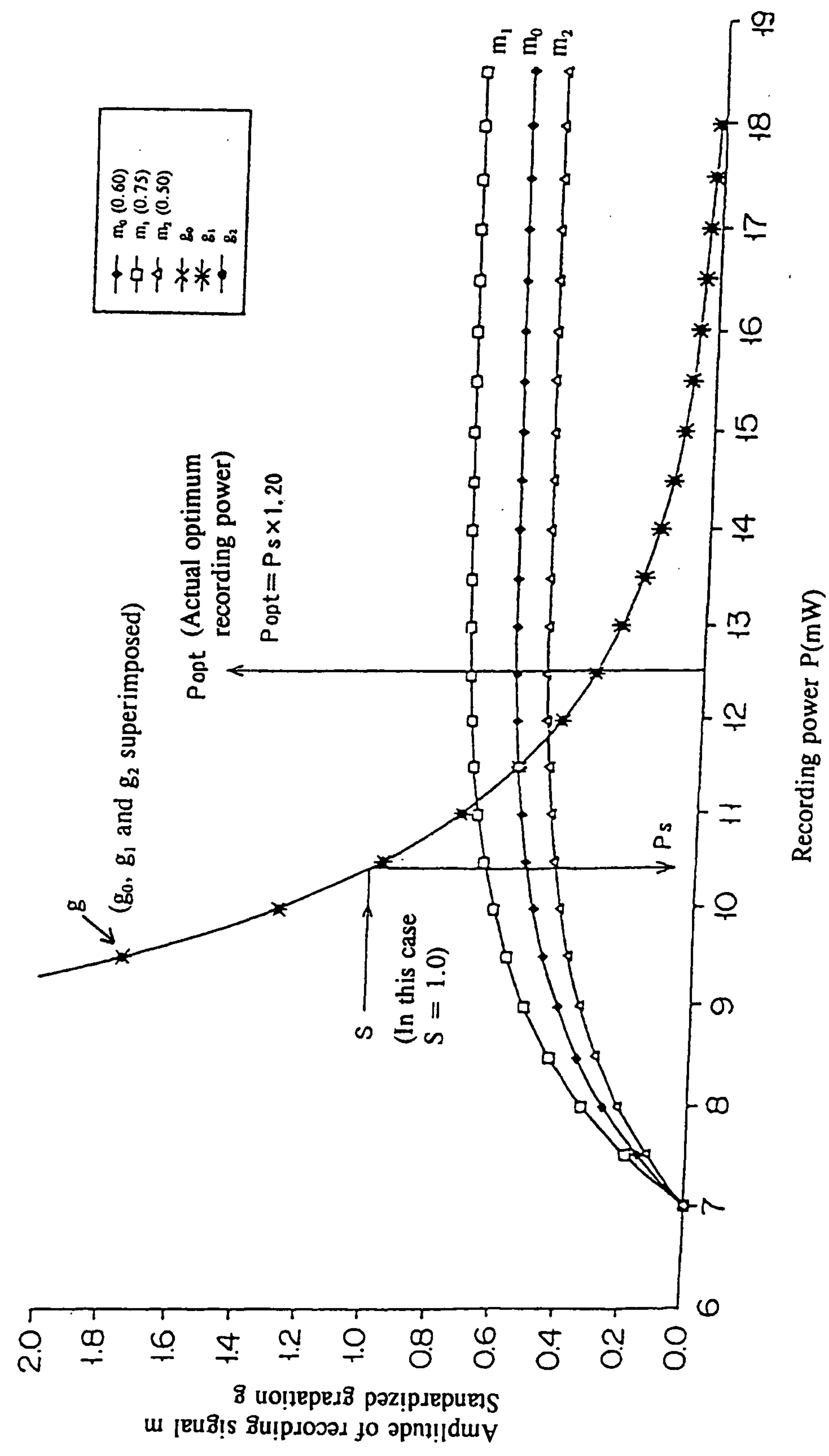
Accordingly, one object of the present invention is to provide an optical data recording/reproducing method and apparatus which can set an optimum recording power without an effect of offset of a recording power and/or an amplitude of recording signal.

Another object of the present invention is to provide an optical data recording/reproducing method and apparatus which can easily set an optimum recording power with a precision acceptable in actual use in an optical data recording/reproducing apparatus designed for mass production.

These and other objects and advantages are achieved by the present invention which provides an optical data recording/reproducing method wherein a data is recorded for testing in a pattern consisting of a not-recorded section and a recorded section as changing a recording power P onto an optical data recording medium from time to time, an amplitude m of the recorded data corresponding to the recording power P is monitored by reproducing the data recorded for testing, a standardized gradation g(P) is calculated from the following expression:

$$g(P)=(\Delta m/m)/(\Delta P/P)$$

FIGURE 4


m0 (0.60)
m1 (0.75)
m2 (0.50)
g0
g1
g2
g
(g0, g1 and g2 superimposed)
Popt (Actual optimum recording power)
Popt = Ps × 1.20
S
(In this case S = 1.0)
Ps
m1
m0
m2
Amplitude of recording signal m
Standardized gradation g
Recording power P(mW)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
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EUROPEAN SEARCH REPORT

Application Number
EP 96 11 4553

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	WO-A-93 26001 (MAXOPTIX CORP) 23 December 1993 * page 1, paragraph 2 * * page 11, paragraph 2 - page 12, paragraph 3 * * page 16, paragraph 1 - page 17, paragraph 2; claims 9,28; figures 2,3 * ---	1,4,5,9	G11B7/125
A	US-A-4 283 785 (MIYAUCHI TOSHIMITSU ET AL) 11 August 1981 * column 3, line 17 - column 4, line 26; figures 4,5 * ---	1-4	
A	US-A-5 268 893 (CALL DAVID E ET AL) 7 December 1993 * abstract * * column 4, line 58 - column 5, line 35; figure 1 * ---	1,4,5	
A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 665 (P-1844), 15 December 1994 & JP-A-06 259769 (RICOH CO LTD), 16 September 1994, * abstract * ---	1,4	TECHNICAL FIELDS SEARCHED (Int.Cl.6) G11B
A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 618 (P-1831), 24 November 1994 & JP-A-06 231463 (MATSUSHITA ELECTRIC IND CO LTD), 19 August 1994, * abstract * ---	1,4	
A	EP-A-0 587 111 (PIONEER ELECTRONIC CORP) 16 March 1994 * abstract * -----	1,4,9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 December 1996	Annibal, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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& : member of the same patent family, corresponding document

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